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## Realizing Sustainability in Facilities Management: a pilot study at the Technical University of Denmark

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### ABSTRACT

**Purpose:** The research project “Sustainability in Facilities Management” addresses the challenge of integrating sustainability in facilities management of existing facilities, to achieve measured improvement of environmental and social performance, to fulfil strategic responsibilities and create shared value. The paper presents a pilot case study on sustainability in facilities management and is intended for a mixed audience of practitioners and researchers. It draws upon the case study findings to establish a baseline of performance and presents practical management implications of integrating sustainability in facilities management (FM).

**Design, methodology and approach:** The approach uses an action-oriented research methodology as a means of co-generation of knowledge on realization of sustainability in FM. Case studies take a phased, multi-method approach including organizational profiling, stakeholder interviews, focus groups, usability evaluations and practice-research workshops. The Technical University of Denmark (DTU) is the pilot case of an international collaboration, and more studies are planned to follow.

**Findings:** The paper presents a framework for qualitative research on Sustainable Facilities Management (SFM), which can guide future research on Sustainability in FM and increase comparability between case studies. The research identifies the challenges and opportunities for integrating ecological, social and economical sustainability in university FM. The paper presents the analysis and conclusions of the pilot case study in the period 2011-2012, including reflections of the case study framework and methodology.

**Practical implications:** FM can play an important role in the transition towards sustainable FM, and this paper presents the lessons learned in the pilot study with conclusions drawn from both practice and research. The lessons learned at the Technical University of Denmark (DTU) are particularly relevant for universities and other public building owners, their Facilities Managers and consultants.

**Research limitations and implications:** The paper is based on literature studies, qualitative research and the preliminary analysis of a single, pilot case study of The Technical University of Denmark. Progress with the other complementary cases will be included in the presentation. The cases should be supplemented by more research on sustainable facilities management.

**Originality and value:** The paper is based on action research to establish a collaborative framework in late 2011 and the findings of the pilot study, and have not been published before.

**Paper type:** Research – case study presentation.

**Keywords:** Action research, environmental, social and economical sustainability, existing buildings.

# 1 SUSTAINABILITY IN FACILITIES MANAGEMENT

As research topic, Sustainable Facilities Management (SFM) is relatively new, although it has been an important issue for FM practitioners for a longer period of time (Junghans 2011). This is due to the increased focus on climate impact, CSR and sustainability as important goals for companies and public institutions, and has become a contributor in the branding of companies. Thus it is of major interest for FM practitioners to seek new knowledge and discuss SFM amongst peers (Møller 2011). This paper contributes to this exchange of ideas and experience, and to the development of sustainable facilities management both as a practical concept and as a research topic in its own right.

Recent research (Nielsen 2011) aimed at understanding application of the concept of SFM at a general level. Based on an analysis of cases of “claims of sustainable FM” it gave some answers to the question: How do FM practitioners approach SFM? It proposed a framework of possible strategies and identified three dominating approaches:

- The incremental: Environmentally friendly FM
- The radical: The Ecological Building
- The transformational: The Sustainable Society

This research (Nielsen 2011) showed that currently SFM is a contested term, is used about a wide range of actions, which are justified within different mindsets and rationalities. There are major differences between organizations with an internal focus or an external focus, and whether they address problems of “today”, or future problems of “tomorrow”, eg. a future where there is no more fossil fuel for ordinary purposes as heating and transportation.

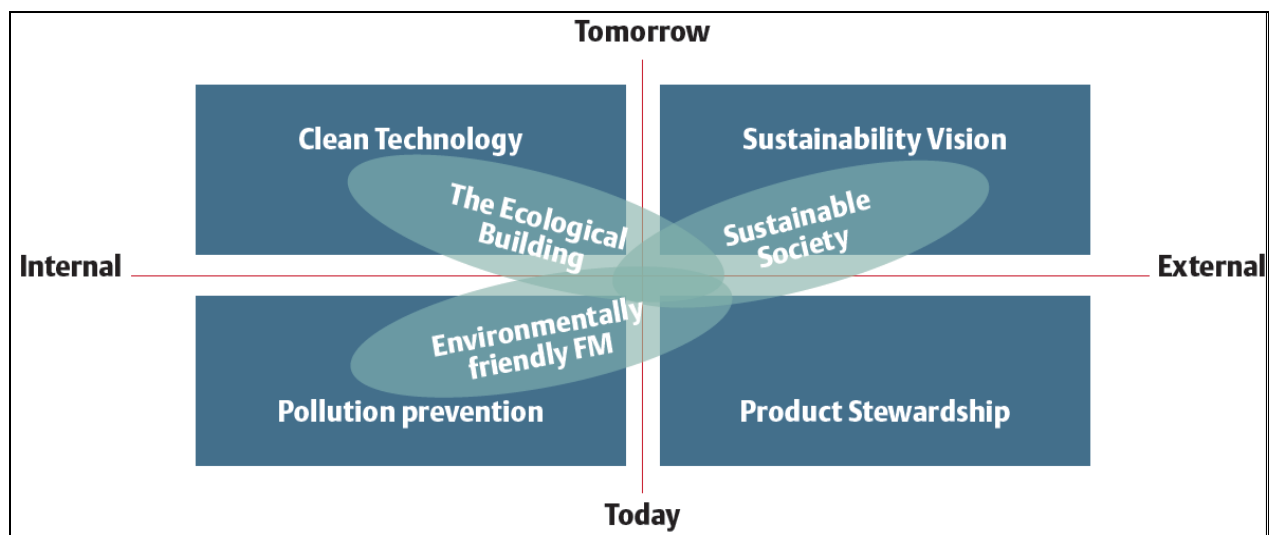


Figure 1: Three strategies of sustainable FM and their strategic positions in relation to sustainability

Debate at the Nordic FM conference at The Technical University of Denmark (DTU) in August 2011 suggested that SFM is a distinct topic of major interest both to practitioners and researchers. It also showed that the FM community is seeking a common understanding of how to bring the broad concept of sustainability “down to earth”, and of how to develop practical methods for implementing SFM. Whereas there is not yet a common consensus on the subject,

several session participants hoped that further research would lead to a common platform of knowledge on the subject. Nielsen (2011) recommends deeper investigation and a collaborative effort from researchers and practitioners to develop SFM in practice and theory.

An embryo group of international researchers including DTU, Zurich University of Applied Science (ZHAW) and the Centre for Facilities Management in Manchester (CFM) are collaborating in research on SFM, and choose FM at DTU campus as the vehicle for a pilot study. The study built on well-established relations between the universities' facilities managers and the research group. Current research on FM at universities (Den Heijer 2007, 2012), (Kok 2011), (I. Price et al 2011) and (Alexander 2011) forms a considerable knowledge pool about the added-value of FM at universities, however the universities' current SFM strategy, intended, deliberate or realized (Mintzberg et al 1998) is not yet researched.

This paper presents the group's framework for case analysis. This framework allows a systemic and explorative approach to SFM analysis and innovation, when applied to a cases in host organisations in a variety of different sectors.

## **2 BACKGROUND**

Shah (2007) produced the first handbook in SFM in practice, setting out general challenges for facilities management in relation to sustainability policy and provided a rich selection of check lists and tools to support practitioners. More recent research literature at conferences and FM journals is reporting SFM case studies (e.g. Price et al 2010 and 2011). With the increasing number of articles it is not possible to refer to all in this paper. But two articles are highlighted in this paper on strategic SFM. (Elmualim et al 2010) describes the barriers and commitment of the facilities management profession to the sustainability agenda. Based on a United Kingdom survey they point to three major barriers for SFM which is lack of time, knowledge and support from senior management. They also point to the need of practical tools as well as more engagement and commitment from facilities managers to overcome resistance towards change. The authors stress that the FM industry is complex, and their research was in position to create an overview of the industry and less on the context specific variation. According to (Durmus-Pedini and Baabak 2010) SFM is also a matter of strategic risk management. Beyond the benefits of going green in terms of environment, health and community, financial and market benefits, there are risks in terms of finance, market, industry, performance and legislative risks. Based on their research Facilities Managers are encouraged to choose which risks to take and to realize initiatives that are reducing the risks.

The paper intends to provide support those who want to develop a stronger SFM strategy by providing a set of analytical steps which can be used to reflect upon an organization's current strategy, intended, deliberate or realized (Mintzberg et al 1998) and to develop ideas of strategic positions in becoming change agents. Mintzberg offers a framework for systematically describe how strategies emerge, and argues that, in order to understand realization processes; one should see the realized strategy as the result of a combination of top-down "intended strategies" and bottom-up "emergent strategies". The term "deliberate strategies" is used to describe that it might turn out that not all intentions are possible to realize, and barriers of different kind lead to "unrealized strategies". The "deliberate strategy" is what is done deliberately and despite eventual barriers.

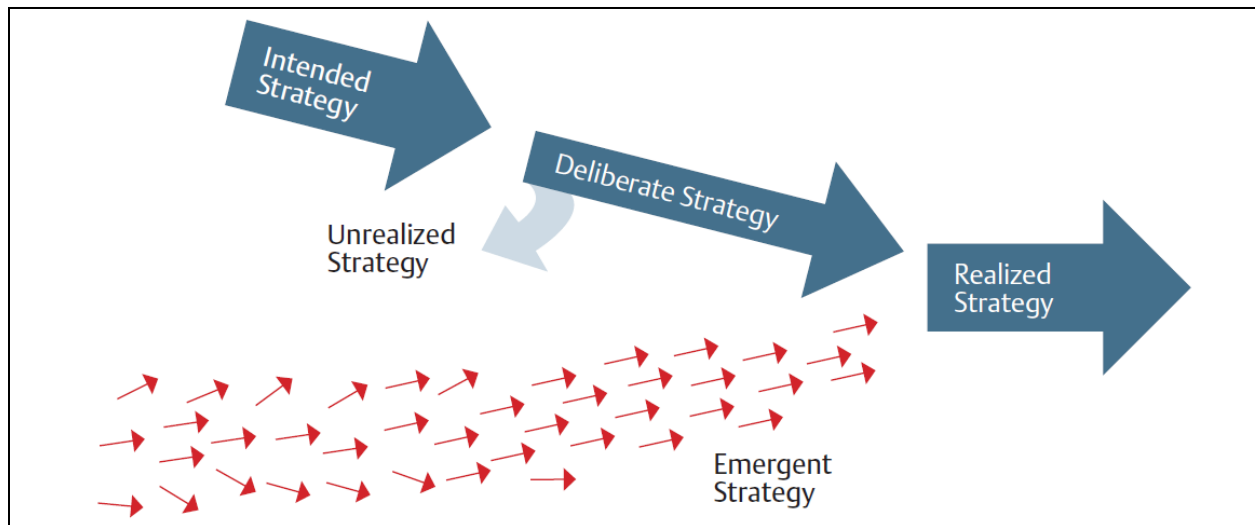


Figure 2: The realized strategy as a combination of emergent, deliberate and sustainable strategy, whereas the unrealized strategy is the part of the intended strategy that was abandoned at some point. After (Mintzbert et al 1998).

Theories of sustainability in FM will be developed from the cases studies of sustainable FM planned in the research. Examples and narratives will be identified to inspire and support Facilities Managers in realization processes. Our research questions are:

- What is the SFM strategy in this specific organisation?
- How did SFM strategies develop in the organisation? The emergent, intended, unrealized, and realized strategies? Described by events, actions, drivers and limitations
- What are the characteristics of SFM in this specific organisation? Are the lessons learned primarily for a unique audience or what could be the generic value?

A handbook on SFM may be produced as an outcome of the project; besides the direct impact the action research project will have the practice partners involved.

## 2 METHODOLOGY: COLLABORATING IN ADVANCING KNOWLEDGE

Knowledge sharing between FM researchers and practitioners in the project aims to understand strategic management processes and reflective processes (hermeneutical processes). From this perspective energy management, for example, is a question of organization and the professional competences (Jäschke, 2008), and is explored through the complexity of a single case, and seeks to discover a variety of sub initiatives at sub cases that can be discussed and reflected beyond the overall storyline.

The case study methodology builds from a conceptual framework for sustainability strategies developed in exploratory research in Denmark (Nielsen 2011), upon a community-based FM model developed in the United Kingdom (Alexander and Brown, 2006, CFM, 2011) and on the evaluation of FM for green buildings in Switzerland (Swiss Sustainable Building Council (SGNI)). The three research partners' development of a collaborative network on SFM creates an opening for contributions from other European countries.

Research teams, initially in three European countries, have adopted a common research design (review of documents, construction of a timeline, interviews with key players, reflections with practitioners about findings and lessons learned). Following completion and evaluation of the Danish case, similar studies will be conducted in the UK and Switzerland. Cross case analysis will be conducted to correlate findings and identify national characteristics. All cases will be organizations committed to incorporating sustainability values through FM.

The DTU Campus Service (Facilities Management) invited Center for Facilities Management – Realdania research to support them in developing and realizing their strategies for realizing sustainability in FM at DTU. The Study of the emergent sustainability strategy at DTU was chosen as a vehicle for the pilot study.

Current collaboration with DTU Campus service (CAS) can be described as:

1. Building relations between partners about common interests in FM (Director of CAS in CFM research centre committee, Chair at Nordic FM, Researcher at DTU, Guest professor at DTU). This continues throughout the duration of the collaboration.
2. Literature review and drafting the analytical frame for data collection
3. Pilot case study - data collection based on documents, explorative interviews (more than 7) and seminars (from August 2011- May 2012). Usability evaluations (Hansen et al 2011) has not yet been applied.
4. Initial analysis of pilot case - evaluation of analytical framework, reflections on first findings, and dissemination of results internally and externally at EFMC2012
5. Additional case studies in Switzerland, The Netherlands, United Kingdom, Norway and other countries. Ideally the more the better, to create a comprehensive database from several cases. Longitudinal studies are aimed at, why the vision is to build a research/practice network around SFM.

Case studies have a phased, multi-method approach including organizational profiling, stakeholder interviews, focus groups, usability evaluation and practice-research workshops. The cases will draw upon research experience from “usability studies” (CIB W111, 2008) and studies of “social learning spaces” at Glasgow University (Alexander 2011), green building council Switzerland (SGNI), and Community based FM in Manchester (CFM, 2011). This knowledge will be used to reflect on and challenge the perspectives and realization of SFM at DTU and in subsequent case organisations.

The research project follows an action research methodology (e.g. Reason and Bradbury 2006), and the type of research where applications in practice and evaluation are ultimate goals for the project. Therefore researchers need practitioners to define the questions to be answered, so the

research is perceived relevant. Practitioners' benefit from reflection partners that can challenge and support development of ideas, inform realization processes and support evaluation practices. This can only be done, when the case organizations are willing to expose their daily work and discuss their daily work, and when mutual trust is established - also open for their sometimes vague intentions, fears and wishes. Through systematic analysis this can lead to case specific lessons learning in a practical context for sustainability in FM, and learning about realizing visions and goals. Validation of research results is in dialogue with the collaboration partners.

### 3 A FRAMEWORK FOR ANALYSING SUSTAINABILITY IN FM

A framework has been developed for analyzing an organization and the process of integrating sustainability in FM. The purpose of the analysis is to enable a common overview among research teams and the FM organization of the historical development and current issues. Subsequently one or several development projects can be identified, addressing visions of the future, and back casting of necessary actions.

The framework is developed to guide case studies and later to inform comparison between cases, identifying similarities and differences. The paper format for the EuroFM conference does not allow a full case report of the pilot case, so this is a general introduction to the analytical framework for mapping the case specific state of the art and motivations for further development is provided.

The check list for data collection and analysis are organized according to three priorities:

1. Enhances the practical relevance of the knowledge production, by emphasizing the context and the development (social construction processes) of locally embedded strategies of sustainability in FM. This means attention to the characteristics of the organisation: Size, type, structure, historical development, private/public/non-profit, and their external stakeholders including the larger system around the university: Government bodies and other stakeholders drawing on typologies developed by (Kaya and Alexander, 2005 , Katchamart, 2011, O'Mara 1999 and others)
2. Allow a wide and holistic understanding of sustainability: Drawing on literature by (Nielsen, 2011; Galamba 2012, Jones, K.J., 2011, Shah 2007 and others). Another source of knowledge and experience is the work done at the Institute of Facility Management, Switzerland by establishing a certification system for sustainable buildings that is very much related to SFM in Switzerland.
3. Approach SFM as a management discipline, and explore ways of realizing sustainability in Facilities Management. Thereby we provide concepts and narratives which can inspire and support reflections on how to realize sustainability in FM in theory and practice. We aim at contributing to the cross-disciplinary decision-making processes primary at strategic, tactical as well as operational level.

An analytical framework has been proposed for the case studies, and information from DTU is used as an example of the content and at the same time communicate characteristics of the CAS case.

Table 1: The analytical framework “Exploring SFM” with key words on the situation at CAS in 2011/2012.

Analytical check list:	Notes on the pilot case: The Danish CAS
<b>Background:</b>  FM host organization <ul style="list-style-type: none"> <li>History</li> <li>Development stages</li> </ul> Informants' backgrounds <ul style="list-style-type: none"> <li>Period of employment</li> <li>Personal competences and careers</li> </ul>	<ul style="list-style-type: none"> <li>The Technical University of Denmark was founded in 1829, and has been based at two locations in the centre of Copenhagen.</li> <li>Lyngby Campus was politically decided in 1958, built in 1960-1977</li> <li>DTU became building owners of Lyngby Campus in 2001 as the first university in Denmark</li> <li>New director of CAS in 2009 with a civil engineering background and years of insight into DTU, and in the centre committee of Centre for Facilities Management-Realdania research.</li> <li>Retirements at CAS lead to a new group of younger leaders with high skills in administration, construction management, technical operation and building operation.</li> </ul>
<b>Context</b> <ul style="list-style-type: none"> <li>Occupying organisation/s</li> <li>User population</li> <li>Internal stakeholders</li> <li>External stakeholders</li> <li>Facilities management organization</li> <li>Urban context</li> <li>Community context</li> </ul>	<ul style="list-style-type: none"> <li>University: Research, education, industrial collaboration and public sector consultancy (2010 budget: € 550 million)</li> <li>Users: 7,000 students, 5,000 staff + visitors and administration</li> <li>Internal stakeholders: CAS, researchers, teachers, administration</li> <li>External: National Government body, local community, the Danish society in general</li> <li>CAS: 1 director, 4 senior group leaders, 11 section leaders, total of 165 employees</li> <li>Suburb to Copenhagen</li> <li>Visionary local authority: Lyngby as knowledge town</li> </ul>
<b>Facility analysis</b> <ul style="list-style-type: none"> <li>Physical, digital and social environment</li> <li>Facilities management scope</li> </ul>	<ul style="list-style-type: none"> <li>Total of 470,000 m<sup>2</sup>, at 6 campuses</li> <li>Standardised buildings, installations and interior: eg. “The 100 meter” buildings.</li> <li>University known for easy interaction between students and teachers</li> <li>From “Teaching room management to “learning environments”</li> <li>Research is everything from desk research to clean laboratories to large scale test facilities</li> <li>Space management to optimise capacity of education facilities (lecture halls, and space for group work). From past the luxury of over-capacity, to present lack of space.</li> <li>Ongoing modernisation since DTU became building owner.</li> </ul>
<b>Sustainability in FM</b> <ul style="list-style-type: none"> <li>Mission and vision</li> <li>Aims and objectives</li> <li>Actions and results</li> <li>System approached</li> <li>Stakeholder involvement</li> </ul>	<ul style="list-style-type: none"> <li>DTU decided a sustainability policy for the whole university. It was drafted by CAS and commits CAS to monitor resource use (green accounts and carbon foot print), to simulate effects as part of planning processes, and to realize sustainability projects together with the university departments (20+). DTU should be visible externally and internally as an elite university with a responsible and trustworthy sustainability profile. Sustainability is understood in a broad sense, including environmental, social and economical dimensions. CAS is coordinator of sustainability in relation to physical layout and operation.</li> <li>CAS action plan 2012 includes: Implementation of DTU sustainability policy in the FM tasks as well as continuous development of CAS as an optimized FM organization for DTU, continuation of strategic campus plan including new buildings and co-locations, competence development at all organizational levels and optimization of area use through space management.</li> <li>From activities for “Energy saving and pollution control” before the sustainability strategy to tactical ways of realizing a systemic lifecycle perspective on sustainability.</li> </ul>



<b>Processes</b> <ul style="list-style-type: none"> <li>• Development processes</li> <li>• Facilities management processes</li> </ul>	<ul style="list-style-type: none"> <li>• University development: Increasing capacity problems</li> <li>• CAS is in charge of: Portfolio management, building client function, operations and space management.</li> <li>• Portfolio management: From 7 (2011) to 2 (2013?) to 3 Campuses (2014?)</li> <li>• Building client function: Campus plan, retrofitting, new buildings, BIOVAF</li> <li>• Operations: Catering, cleaning and moving is outsourced. Inhouse organisation for: e.g. fault reporting, reception, guard, green areas and other.</li> <li>• Space management: Location plans, booking, key system, emergency plans, party plans (receptions, annual social gathering), climate protection plans</li> <li>• Established building information system</li> </ul>
<b>Resources</b> <ul style="list-style-type: none"> <li>• Budget</li> <li>• Organisation competences</li> <li>• Access to other resources</li> </ul>	<ul style="list-style-type: none"> <li>• The building portfolio is estimated at DKK 2,5 billion (365 million Euros).</li> <li>• Investments plans for new buildings</li> <li>• Reduced budget for administration and operation in 2010</li> <li>• Action plan includes competence development at all organisational levels</li> <li>• A sustainability coordinator was employed in January 2012, with experience in greening a university, sustainability projects</li> <li>• Use of external consultants and collaboration with relevant DTU researchers. Open for new suppliers and partners.</li> <li>• Employees at DTU departments represent considerably polytechnic knowledge which CAS can consult</li> </ul>
<b>Evidence-based Performance</b> <ul style="list-style-type: none"> <li>• Environmental</li> <li>• Social</li> <li>• Economical</li> </ul>	<ul style="list-style-type: none"> <li>• Green accounts since 2005. Since 2009 distinctions between energy use in rented and owned locations, as basis for prioritizing energy investments. Changes in 2011 in methodology for measuring space.</li> <li>• Monitoring of energy use, leads to attention to CTS and ventilation.</li> <li>• Simulation of expected energy use in new buildings leads to focus on core research facilities and less on the building and building heating (only 10-20%).</li> <li>• Roof renovation is combined with green roofs and extra insulation</li> <li>• Organic material from the outdoor campus area is composted internally.</li> <li>• University is built with a large infiltration trenches, which are being renovated</li> <li>• 1 year CO<sub>2</sub>-accounting at the Risø Campus showed researchers travelling by airplane was among the largest contributors.</li> </ul>
<b>Outcomes</b> <ul style="list-style-type: none"> <li>• Benefits realization</li> </ul>	<ul style="list-style-type: none"> <li>• (Not appointed) Stewardship among Danish Universities in FM</li> <li>• Attractive work place measured in applications for vacant positions</li> </ul>
<b>Recognition</b> <ul style="list-style-type: none"> <li>• Certificates, prizes and other</li> </ul>	<ul style="list-style-type: none"> <li>• Universities' award for landscape plan in 1970's</li> <li>• DTU in top university ranking</li> <li>• DTU received a prize for the many flexible working places in kitchens and in maintenance of green areas in autumn 2011 from the local municipality, appreciation of social responsibility.</li> <li>• FM certificates or building certificates is not a specific goal in itself</li> </ul>
<b>Experience gained</b> <ul style="list-style-type: none"> <li>• Surprises</li> <li>• Disappointments</li> <li>• Most appreciated learning</li> <li>• Recommendations</li> </ul>	<ul style="list-style-type: none"> <li>• Limited effect of building regulations of insulation of new buildings because the process energy is much higher (up to 90% of total energy use)</li> <li>• Economic savings from entering the electricity commodity market</li> <li>• E.g. increase in energy consumption due to decision on inhouse "server solution", increased activities and new research facilities.</li> <li>• Interest in challenging Danish consultancy companies and suppliers on effectiveness, innovation and sustainability</li> <li>• Sustainability as part of a DTU quality concept</li> </ul>
<b>Other</b>	<ul style="list-style-type: none"> <li>• Use of ground water cooling, and centralized cooling systems, to increase renewable energy</li> <li>• Intentions of climate adaptation plans: Risk analysis related to storm water flooding. Basements full of valuable equipment.</li> <li>• The Danish Minister of Climate, Energy and Buildings is planned to come to DTU to learn about The DTU way of FM/SFM.</li> </ul>

## 4 DTU CAMPUS SERVICE CASE STUDY

The following is a presentation of the pilot case and how sustainability has evolved in FM at the university as a fifth core business at DTU beyond education, research, industrial collaboration and public sector consultancy. The first section provides an overview of the evolution process so far; whereas the two following sections are concrete examples of initiatives where considerations of sustainability are incorporated in university FM.

### 4.1 Reconstruction of the realized SFM strategy at DTU

The following is a reconstruction of how SFM has evolved as a somehow uncoordinated pattern which in retrospective outlines the realized SFM strategy from its official opening in 1974 and until February 2012. This gives a background for understanding the SFM and the opportunities and challenges of realizing short and long term visions. In the following the Sustainability policy document is used as a reference for the time “before the policy” and “after the policy” in the interviews and in the following analysis.

**The emergent strategy:** These are initiatives from the time before the sustainability document, but today can be interpreted as part of the sustainability profile and the realization of sustainability in university FM, and can be understood as examples of how sustainability has been included in decision making even before the sustainability policy. Examples are: Ground water cooling at Risø campus, energy monitoring and green accounts energy/water/paper/waste, and campaigns at department level.

**The intended strategy:** In this case this is stated in the Sustainability policy document, which will be a reference for the annual “development and action plans” in CAS. It includes the following statements (authors translation): The policy support DTU vision about being a globally recognized technical elite university; gives direction for the work on reducing the universities climate and environmental burden, and it shall be visible internally and externally as an elite university which acts in a responsible and reliable manner to environmental sustainability and climate change.

**The deliberate strategy:** Since intended strategy is relatively new and relatively general, it is a bit early to say precisely what will end up as the deliberate strategy. However, the sustainability policy and the overall campus plan is important to establish a basis for FM and SFM, and the intention is to develop this further in order to clarify visions and back casting a realization process. At tactical level it is to use the possibilities that are connected to: Portfolio management, the building client role, the operation and the space management. The strategy on operational level still has to unfold. But on their agenda the management group has to work with the employees, users and suppliers to ensure the continuation of better project management, better basis for simulations and realisation of sustainability projects.

**The unrealised strategy:** Some ideas have not been realised despite the intentions of being pioneers and contributors to transition to a sustainable society. An example is the purchase of electrical cars. So far it is CAS’ decision not yet to invest in this technology.

The motivation for SFM is clear from the director of CAS, and the perspective is also at place at a general level without the next steps and the tactical decisions are fully in place. This leaves a

very exiting gap between intentions and implementation, which we will address in the continuous action research process.

#### **4.2 Energy management: Optimizing lab facilities with users**

To give a concrete example of how energy management is reducing environmental impact, the following briefly describes an ongoing project on retrofitting fume cupboards. When the 1,000 fume cupboards were built around 1970, they were designed in the same way, and always designed with full ventilation. In practice, the fume cupboards are used in many different ways and with different intensity, some only a few times a year. There is now an overview of new technical possibilities for differentiating ventilation intensity; general design criteria have been developed together with the health and safety personnel at DTU; and there has been a user innovation workshop with laboratory personnel to develop a new facility design. This design will now be tested in a pilot project, before the idea is implemented on a larger scale.

This project is an example which illustrates a working method, where a facility is not just a technical facility, but attention is paid to the actual user situations, and CAS has the perspective of developing energy efficient facilities, user needs and user behaviour at the same time.

The general lesson learned is that at DTU the equipment for research can be extremely energy/water consuming, and even though researchers have to do their research, the FM department is eager to optimise the operation and to minimise the consumption, when the facilities are not in use.

#### **4.3 The Campus plan and sustainability in briefing of new buildings**

A campus plan was made in 2010 as a master plan for the many upcoming construction projects at the Lyngby Campus. Sustainability is only indirectly mentioned, but there are still elements which can be interpreted as support for environmentally friendly FM strategy.

The viewpoint is that the most sustainable building is the building that is not built, especially from an environmental and economical perspective. Space optimization and multipurpose areas is a dominating principle in the campus plan, which aims at reducing the need of space, and therefore some reduction in energy for heating, lighting and cooling, and material for the building. From experience CAS already knows that space optimisation and multipurpose areas will call for better booking systems and a cultural change project to ensure proper use and satisfied users. When new buildings are discussed with the researchers and directors of departments, they generally ask for larger spaces only for their own department use. Shared space and multi users are rarely suggested by the individual stakeholders.

As building owner and facilities manager CAS has an interest in the total lifecycle costing (environmentally and financially). This has lead to a requirement in the briefing process for those participating in the architect competitions; they always have to include a description of the operation of the building, and not just the building as the final product. In Denmark this is a relatively new and voluntary requirement, when going beyond the energy classification of the building, which is obligatory by law.

## 5 DISCUSSION

The case study of DTU is an informative case about pioneering in realising sustainability in FM in Denmark, and it is an informative case at the early stages of a realisation process. As researcher it is a unique possibility to follow the development and the dynamics of the development process, and the research has found elements of all three SFM strategies identified by (Nielsen 2011): Environmentally friendly FM (primary in operation, and building client role), the sustainable building (primary in portfolio management, building client role) and transformation to sustainable society (in projects on e.g. ground water cooling and district heating as well as the general priority of collaboration and knowledge sharing).

DTU has an intended sustainability strategy where CAS plays a central role. The question is how, and the challenge for the Campus director is to define the long term perspective that can be used e.g. for back casting the next steps to take in a realisation process. The interviews with campus director and other leaders within CAS reveal some divergence in the understanding of the term sustainability in the management group, and the question is also what kind of steering principles to apply in the managerial framing of FM and sustainability in FM (Galamba 2012): Bureaucracy, new public management or a relational governance paradigm.

## 6 CONCLUSIONS

The research project and pilot case study aim at providing a basis for in depth studies of realization of SFM. At this stage a framework is established, tested and further developed in the case study of DTU. It should be debated if and how this framework can be improved to better support knowledge production. In our view this is a good starting point, which supports the context specific in depth analysis of SFM, and it is flexible in terms of available information. A weak point might be the size and complexity of a case like DTU which makes it an endless research for collecting more information. When is the amount and the quality of information sufficient, and how should lessons learned should be communicated, as combinations of quantitative data and qualitative descriptions? More quantitative descriptions than presented in this paper would make it possible to do the conventional benchmarking or relate to building certificates. However this kind of information is not always available. The analytical framework is tested in one pilot case. Longitudinal studies and the supplement of more cases will form a basis for generalized knowledge about realization of SFM.

It has been proposed that for Facilities Management to advance as a discipline and a profession, effective collaboration between research and practice is needed in order to develop a robust and reliable knowledge base (Alexander and Nielsen, 2011). The research project SFM has developed with such collaboration in mind. An international alliance with practitioners and researchers has been established to explore and reflect in a joint process about the realization of SFM.

An analytical framework is developed and tested in the pilot case and provides an idea about SFM at strategic and tactical level. The reconstruction of the realized strategy at DTU shows that it started with an emergent strategy with a campus designed with storm water infiltration, composting facility etc. Later an effort of energy management, and green accounting at university level was established (since 2005) as an emergent strategy. The first intended

sustainability strategy was decided in 2011 and the deliberate strategy still has to be further developed, but a promising process is started of realising an integration of sustainability in FM. A process from which both researchers and practitioners learn.

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